REMARKS

This amendment is being filed in response to the Office Action having a mailing date of February 18, 2004. Independent claims 1, 7, 11, and 17-19 are amended as shown so as to better recite certain distinctive features. No new matter has been added. With this amendment, claims 1-22 are pending in the application.

In the Office Action, claims 1, 6-8, 11-13, and 16-22 were rejected under 35 U.S.C. § 102(b) as being anticipated by a newly cited reference to Betts (U.S. Patent No. 5,812,537). Claims 2-5, 9-10, and 14-15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Betts in view of Agazzi (U.S. Patent No. 4,669,116). For the reasons set forth below, the applicant respectfully requests the Examiner to reconsider and to allow all of the pending claims.

As previously described in the prior-filed amendment of December 10, 2003, one embodiment provides an echo cancellation technique that can provide for cancellation of echo signals imparted on received signals of a modem and also for cancellation of various nonlinearities that are present in the transmit circuitry (*see, e.g.*, the Abstract, Figures 3-7, and the accompanying description in the present application). As detailed in the prior-filed amendment, one embodiment of the echo canceller has a transfer function that is based upon a transfer function of a line coupling present in the digital communication system, thereby more effectively canceling echo and/or nonlinearity.

The independent claims were amended to recite that the echo canceller has a transfer function that is based on the transfer function of a line coupling present in the digital communication system, or other similar language. The Examiner conceded that this feature distinguishes over the reference of Puhl (U.S. Patent No. 4,629,829), and therefore, withdrew Puhl in the present Office Action as a basis for rejection.

However, in the present Office Action, the Examiner has cited Betts as disclosing the transfer function feature, as well as the other elements recited in the independent claims. The applicant respectfully disagrees with this rejection based on Betts.

For example, as depicted in Figure 3 of the presented application, the echo canceller 310 is coupled to an output terminal of the transmitter 306. An analog-to-digital

converter (ADC) 312 converts the analog output signal from the transmitter 306 into a digital signal that is provided to the echo canceller 310. Such an embodiment is in contrast to what is shown in Figure 2 of the present application as the prior art. In Figure 2, an echo canceller 210 is coupled to an input terminal of a transmitter 204. The echo canceller 210 and the transmitter 204 thus receive the same input signal. As described in further detail on page 4, lines 7-11 of the present application, placing the echo canceller 210 prior to the transmitter 204 to receive the input signal does not result in cancellation of nonlinearities that are introduced by the transmitter 204. That is, since the echo canceller 210 is receiving a signal that has not yet been introduced with nonlinearities caused by internal elements of the transmitter 204, the echo canceller 210of Figure 2 cannot effectively operate to remove the nonlinearities.

Betts discloses a system that is similar to what is shown in Figure 2 of the present application. In Figure 3 of Betts, an echo canceller 650 is coupled to receive a signal 607, and wherein the echo canceller 650 is controlled by a CPU and memory 630 via a line 682. As described in further detail on column 4, lines 40-64, a binary input data sequence $\{x_k\}$ is provided to a transmitter 605 via a line 11. The input data sequence $\{x_k\}$ is processed by a transmitter 605 to form a transmitted signal ns(t), which represents a quadrature amplitude modulated (QAM) signal output on a line 606. The QAM signal ns(t) is then provided to a hybrid 610, and in turn to other components.

The echo canceller 650 of Betts is not coupled to receive the QAM signal ns(t) on the line 606 that is output from the transmitter 605. Rather, the echo canceller 650 is coupled to receive the input data sequence that is initially provided to the transmitter 605, or more particularly, the input data sequence represented as a sequence of complex-valued symbols $\{a_n\}$ at 607. *See, e.g.*, column 4, lines 57-60 of Betts. Therefore, with the system of Betts, the $\{a_n\}$ signal received by the echo canceller 650 does not include characteristics associated with linearities that may be introduced by the transmitter 605, since the signal $\{a_n\}$ is directly derived from the input signal $\{x_k\}$ into the transmitter 605, and is not the output QAM signal ns(t) or a signal representative thereof. In this regard, Figure 3 of Betts is similar to Figure 2 of the present application, in that the echo canceller is coupled to an input terminal of the transmitter so that

both the transmitter and echo canceller receive substantially the same input signal, which therefore does not have linearities introduced by the transmitter.

It is believed that the independent claims as presented in the previous amendment already have language that distinguishes over Betts. The claims and at least some of the distinguishing language are listed below:

- In claim 1: "generating an analog output signal by said first transmitter" and "performing echo cancellation based on said analog output signal."
- In claim 7: "sampling an analog output signal provided by a local transmitter, said analog output signal including characteristics associated with a nonlinearity introduced by said local transmitter," "converting said analog output signal into a corresponding digital signal" and "producing a compensated digital signal... wherein said nonlinearity is substantially eliminated from the compensated digital signal."
- In claim 11: "a transmitter to provide an analog output signal" and "an echo canceler having an input signal and an output signal, wherein said input signal is essentially the analog output signal."
- In claim 17: "generating an analog output signal by said first transmitter," "sampling said analog output signal" and "performing echo cancellation based on said sampled analog output signal."
- In claim 18: "sampling an analog output provided by a local transmitter, said analog output including...characteristics associated with a nonlinearity introduced by said local transmitter."
- In claim 19: "a transmitter to provide an analog output signal" and "an echo canceler having an input signal...wherein said input signal is essentially the analog output signal."

Therefore, the above-quoted language makes it clear that the echo cancellation is based at least in part on an output analog signal that is generated by the transmitter and which includes characteristics that are associated with nonlinearities introduced by the transmitter. The use of the term "output" in this element further clarifies that it is an output signal from the transmitter, and not an input signal to the transmitter, from which the echo cancellation is based. Such recitations clearly distinguish over Figure 3 of Betts, since the echo canceller 650 of Betts

receives a sequence (a non-analog input) of data $\{a_n\}$ that is directly obtained from the input data sequence $\{x_k\}$ into the transmitter 605, and since further, the echo canceller 650 of Betts does not receive the output signal ns(t) or other signal derived therefrom.

However, to facilitate prosecution, the independent claims are nevertheless amended to make it further explicitly clear that the echo cancellation is based on an analog output signal provided by the transmitter and/or with the analog output signal including characteristics that are associated with a nonlinearity that is introduced by the transmitter.

In independent claim 1, the claim is amended to recite that the analog output signal includes --characteristics associated with a nonlinearity introduced by the first transmitter--. The claim is further amended to recite that the echo cancellation is performed based on the analog output signal that --includes the characteristics associated with the nonlinearity--. Because the echo cancellation recited in claim 1 now ties together the analog output signal generated by the transmitter and the characteristics associated with the nonlinearity recited therein, amended claim 1 now further distinguishes over Betts and is now allowable. As described above, Betts does not meet either or both of these recitations or other recitations.

Betts does not perform echo cancellation based on an analog output signal. Rather, Betts performs echo cancellation based on an input data sequence $\{a_n\}$, which is neither analog nor an output from the transmitter 605. Moreover, the input data sequence $\{a_n\}$ of Betts does not include characteristics associated with linearities introduced by the transmitter 605, since input data sequence $\{a_n\}$ is not a transmitted output signal.

Independent claim 7 is amended to recite that the echo canceller --receives the sampled analog output signal that includes characteristics associated with the nonlinearity--. This is a feature that is not disclosed, taught, or suggested by Betts. As described above, Betts involves an echo canceller 650 that has an input signal that does not include characteristics associated with a nonlinearity that is introduced by the transmitter 605. Accordingly, amended claim 7 is allowable over Betts.

Independent claim 11 is amended to recite that the analog output signal has --characteristics associated with a nonlinearity introduced by the transmitter--. The claim is further amended to recite that the input signal of the echo canceller is essentially the analog

output signal provided by the transmitter. These features distinguish over Betts as described above. Moreover, the claim is amended to recite that the input signal is essentially the analog output signal that has the --characteristics associated with the nonlinearity--, which is a feature that is clearly not disclosed, taught, or suggested by Betts. Accordingly, amended claim 11 is now further allowable over Betts.

Independent claim 17 is amended to recite that the analog output signal includes --characteristics associated with a nonlinearity introduced by the first transmitter--. The claim is further amended to recite that the echo cancellation is performed based on the sampled analog output signal --having characteristics associated with the nonlinearity--. These are features that are not disclosed, taught, or suggested by Betts, since the output QAM signal ns(t) of Betts is not used for performing echo cancellation. Instead, Figure 3 of Betts uses substantially the same input signal $\{a_n\}$ as the transmitters 605 to perform echo cancellation.

Independent claim 18 is amended to recite that the echo canceller receives --the sampled analog output that includes the characteristics associated with these nonlinearities--. This is a feature that is not found in Betts, and therefore, amended claim 18 is now further allowable over Betts.

Independent claim 19 is amended to recite that the analog output signal has --characteristics associated with a nonlinearity introduced by the transmitter--. The claim is further amended to recite that the echo canceller is --coupled to an output terminal of the transmitter--. As shown in Figure 3 of Betts, the echo canceller 650 is not coupled to an output terminal of the transmitter 605 in a manner that receives the output signal ns(t) on the line 606. Accordingly, these limitations further distinguish over Betts. Claim 19 is also amended to recite that the input signal to the echo canceller has the characteristics associated wit the nonlinearity, which is not a feature disclosed, taught, or suggested by Betts since Betts taps the input signal $\{x_k\}$ to the transmitter rather than the output signal ns(t). As such, amended claim 19 is further allowable over Betts based on several recitations contained therein.

Overall, none of the references singly or in any motivated combination disclose, teach, or suggest what is recited in the independent claims. Thus, given the above amendments and accompanying remarks, the independent claims are now in condition for allowance. The

dependent claims that depend directly or indirectly on these independent claims are likewise allowable based on at least the same reasons and based on the recitations contained in each dependent claim.

If the undersigned attorney has overlooked a teaching in any of the cited references that is relevant to the allowability of the claims, the Examiner is requested to specifically point out where such teaching may be found. Further, if there are any informalities or questions that can be addressed via telephone, the Examiner is encouraged to contact the undersigned attorney at (206) 622-4900.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

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